Unmanned Aircraft Systems (UAS) in the USGS

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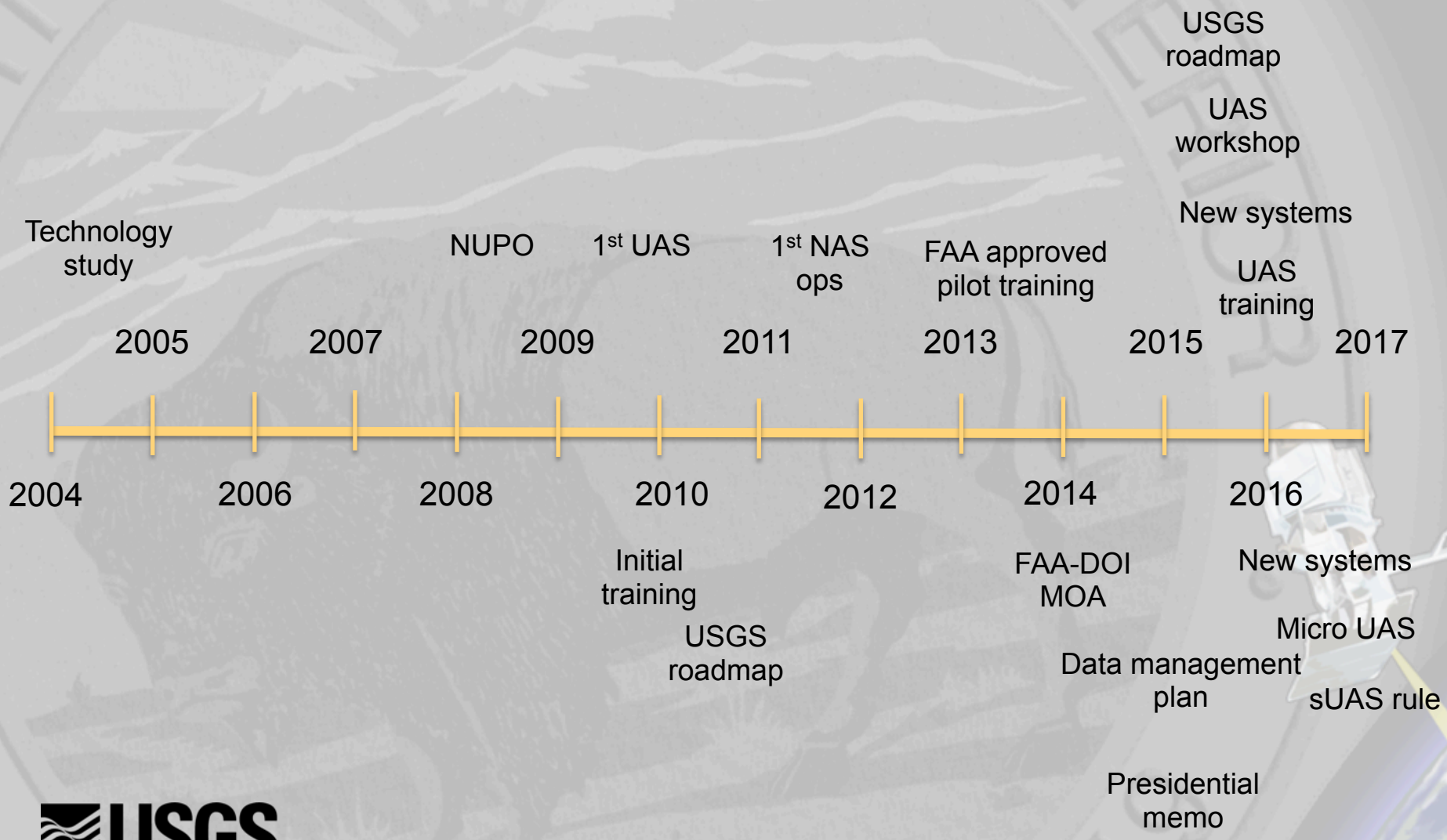
U.S. Geological Survey

December 7, 2015

UAS Milestones



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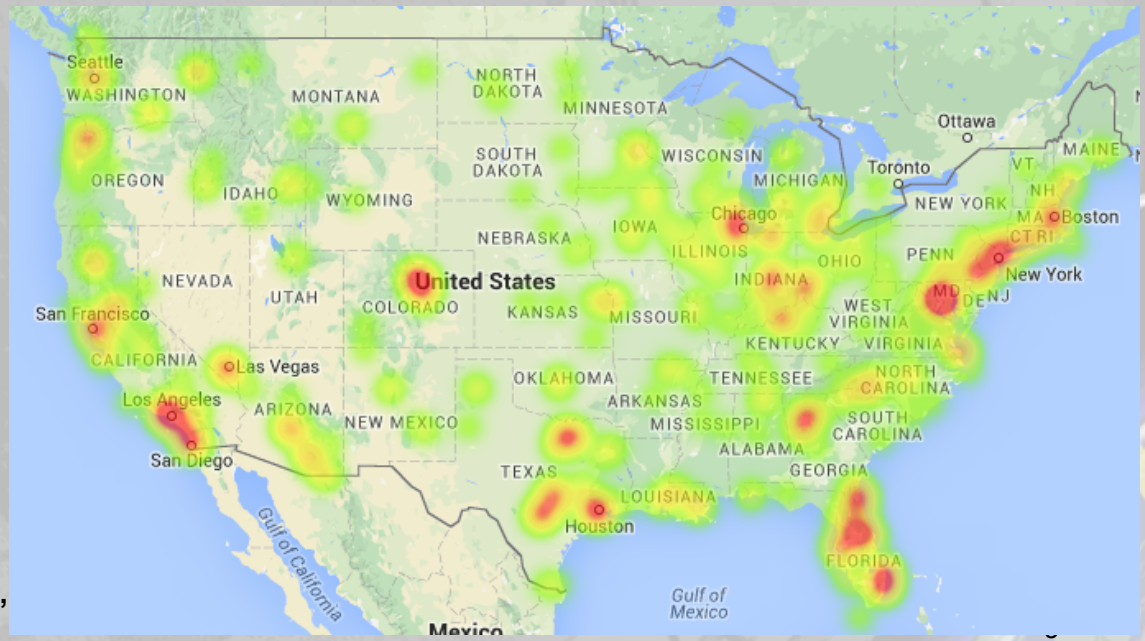
FAA and UAS

Congress included language and milestones requiring the integration of UAS into the National Airspace System (NAS) in the FAA Modernization and Reform Act of 2012, integration by September 30, 2015

FAA considers all UAS as "aircraft" ("Aircraft" means any contrivance invented, used, or designed to navigate, or fly in, the air. 49 U.S. Code § 40102)

Section 333 of 2012 Act – over 2400 exemptions for commercial work

1. Real estate
2. Aerial surveying
3. Aerial photography
4. Agriculture
5. Aerial inspection
6. Construction
7. Infrastructure inspection
8. Utility inspection
9. Film & TV
10. Environmental



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June 2015 333 "hotspots"

FAA and UAS (cont.)

Small UAS Notice of Proposed Rulemaking (NPRM)

- Proposed framework of regulations for commercial operations
- Available for public comments February – April 2015, > 4500 comments
- Final rule expected by June 2016

UAS registration

- Aircraft numbers
- User – task force plan submitted November 20

Where you can fly tools – https://www.mapbox.com/drone/no-fly/

B4UFLY – http://www.faa.gov/uas/b4ufly

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FAA and DOI

FAA - Develop and oversee Federal Aviation Regulations

Office of Aviation Services (OAS) - Develop and oversee overarching DOI policies and programs

DOI OAS OPM-11
DOI Use of UAS

Only OAS can purchase UAS

Bureaus - Develop implementing bureau policies and programs

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FAA and DOI (cont.)

Memorandum of Agreement (MOA)

- Originally signed Dec. 24, 2013 (updated Sept. 2015)
  - Under 1,200’
  - Line of sight
  - 5 nm from an airport (control tower)
  - 3 nm from an airport (published instrument procedures)
  - 2 nm from an airport (not having published instrument procedures)
  - 2 nm from a heliport
  - Not over people or urban settings
  - NOTAM
  - VFR weather minimums and allowed to fly at night
  - File Certificate of Authorization (COA) 48 hours prior to mission – file and fly
- https://www.doi.gov/sites/doi.opengov.ibmcloud.com/files/uploads/DOI_FAA_MOA_Class_G_09112015.pdf

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What is the DOI UAS Strategy

DOI's UAS program strategy is tailored to the mission, funding, personnel, and infrastructure levels of the Department and is summarized as:

- **Focus on small UAS (sUAS), which are more aligned with DOI's decentralized mission execution strategy and more supportable by the Department's funding, personnel and infrastructure levels.**
- **Leverage available excess DOD sUAS to minimize procurement, training, and support costs.**
- **Establish partnerships with Federal departments who possess UAS capabilities beyond DOI's to support DOI missions that require more extensive UAS capabilities.**
- **Conduct operational tests and evaluations of various UAS technologies to support the development of long-range UAS requirements and strategy for the DOI UAS activities.**
- **Based on the requirements and strategy developed above, procure (buy or contract) for UAS capabilities that cannot be met either through excess DOD sUAS or those available through partnerships with other Federal agencies.**

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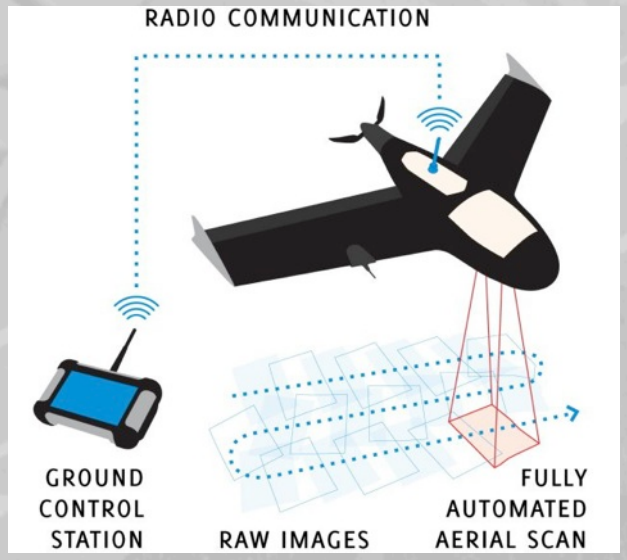
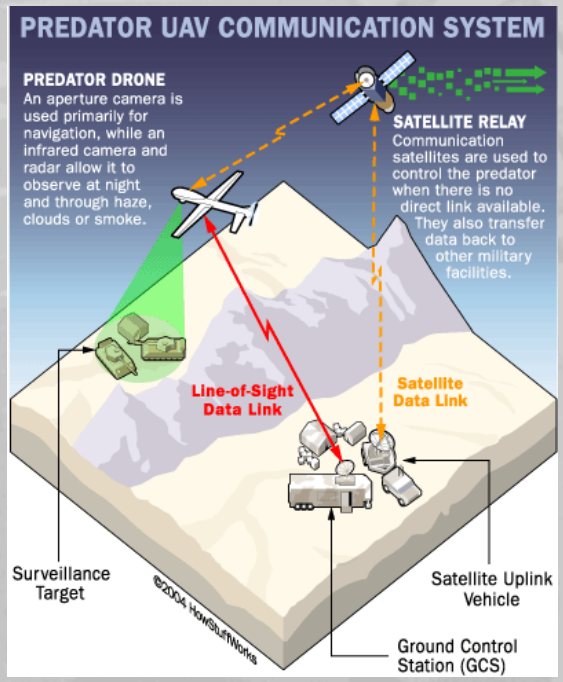
https://www.doi.gov/aviation/uas

How a UAS Works



Line-of-Sight (LOS)

DOI mode of operation



Beyond-Line-of-Sight (BLOS)

Radio line-of-sight
Visual line-of-sight

Sensors

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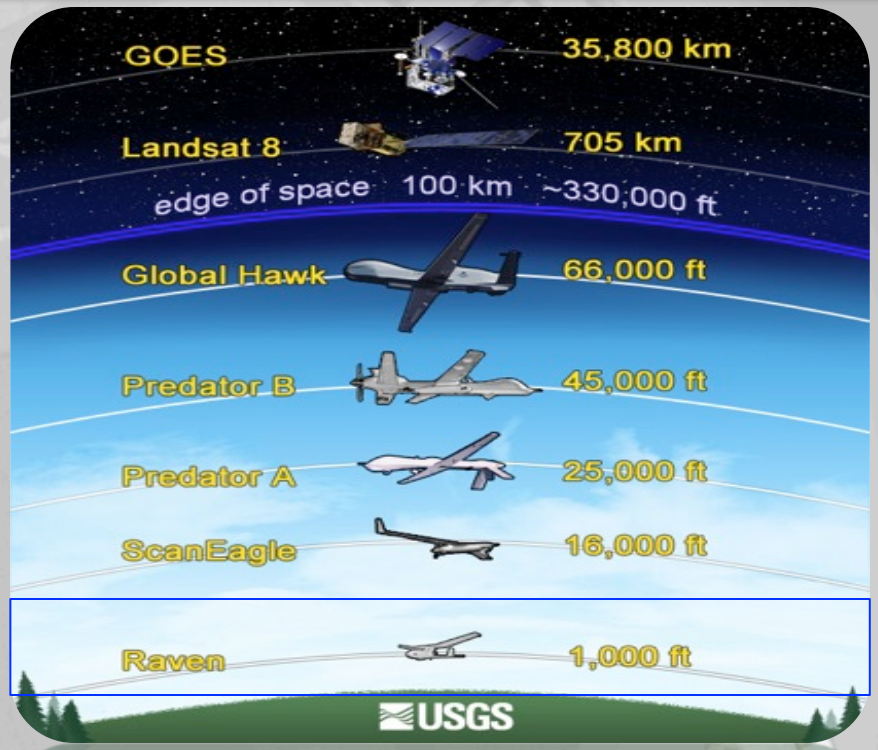
Why Use a UAS

Satellites provide periodic observations over regional/continental areas at low spatial resolutions

Manned aircraft can collect data over large spatial areas with a variety of sensors

Field surveys acquire many types of information over small spatial areas

UAS facilitate science driven remote sensing data acquisitions and compliment the other observations



Landsat 8 (30 meter)

NAIP 2010 (1 meter)

UAS at 400 ft (5 cm)

UAS at 200 ft (2.5cm)

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USGS National UAS Project Office

Supports the technology transfer of UAS capabilities to enhance the informed decision making across the Department

- Established in 2008
- Collaborates on operational test and evaluation missions with other DOI bureaus and Office of Aviation Services (OAS)
- Evaluates emerging technologies
- Develops new products and capabilities
- USGS UAS Roadmap 2014

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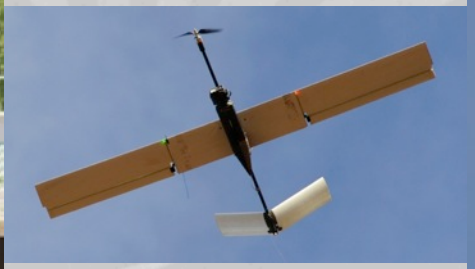
http://uas.usgs.gov/

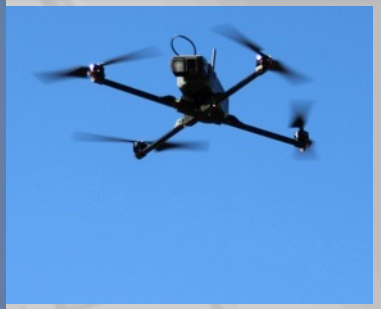
DOI UAS Platforms

Pulse Vapor 55



Falcon

MLB Super Bat



Falcon Hover

- All sUAS - 7 to 37 lbs
- Both fixed wing and rotor
- Both electric and gas
- All flown LOS
- Endurance - 20 minutes to 6 hours
- Payloads – DSLR, TIR, custom
- Payload weights - .5 to 8 lbs

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UAS Technology - Sensors

Current

- **GoPro Hero 3 & 4 - 1080P & 4K HD camera (still frame and video)**
- **Canon SX260HS & S100 – GPS enabled (RGB and IR) – CHDK**
- **Sony ActionCam – GPS enabled**
- **Ricoh GR – no GPS**

Future

- **Multispectral, Hyperspectral**
- **Lidar, Thermal**
- **Chemical/Air Sampling**
- **Radio Relay/Tracking**

Collaborating with the University of Florida on developing new rotorcraft with multiple sensors

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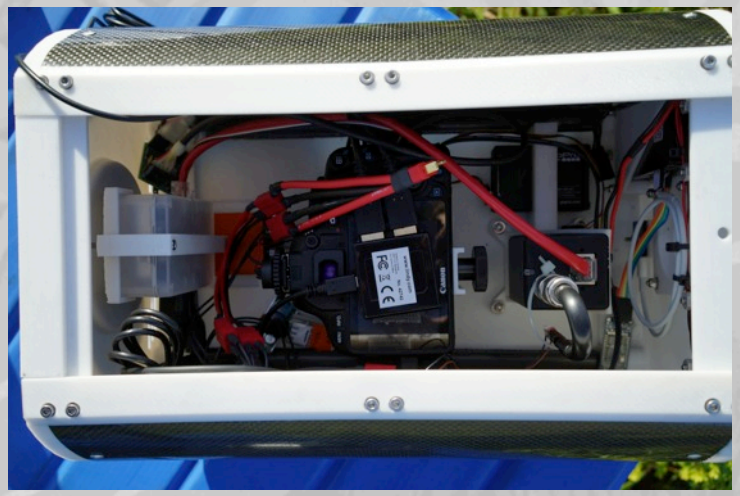
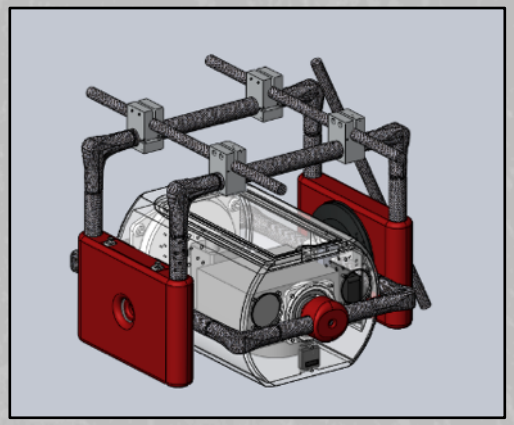
DJI S1000+ Octocopter



2-Axis Gimbal Setup



EO, TIR and multispectral sensors

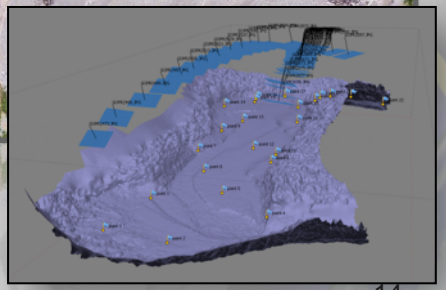
UF UNIVERSITY of FLORIDA

Unmanned Aircraft Systems Research Program

Elwha Dam Removal and River Restoration

Olympic National Park, Washington

Monitoring sediment volumes eroded from the reservoir and deposited downstream, where the mobile sediment can potentially affect salmon habitat and flood-stage elevation



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Debeque Landslide

Debeque, Colorado

June 2013

October 2013

Temporal series of Landslide models monitoring geomorphic processes.

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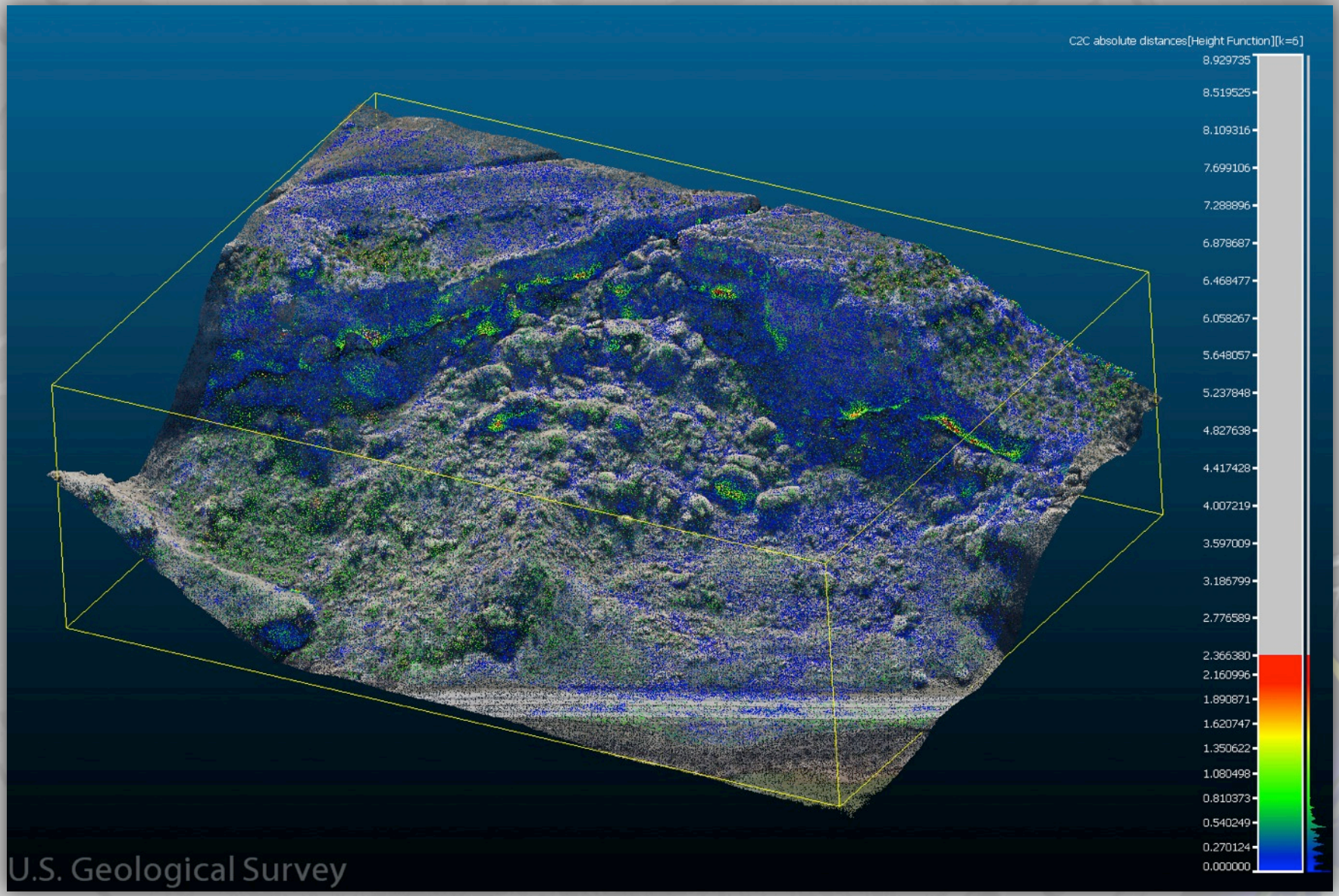
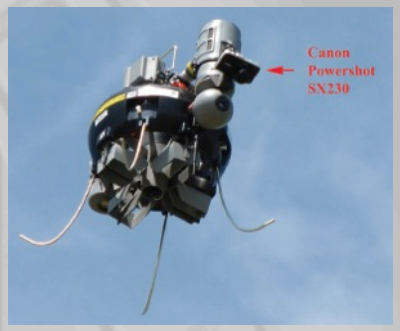
Debeque Landslide

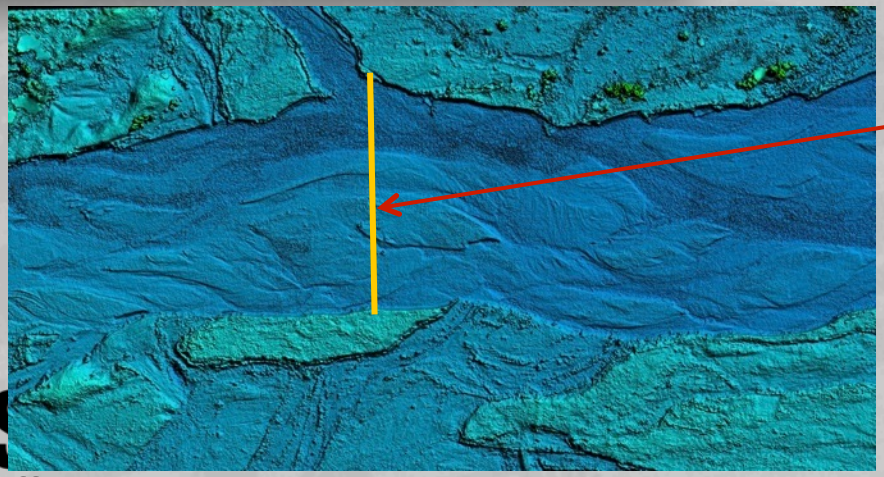
Debeque, Colorado

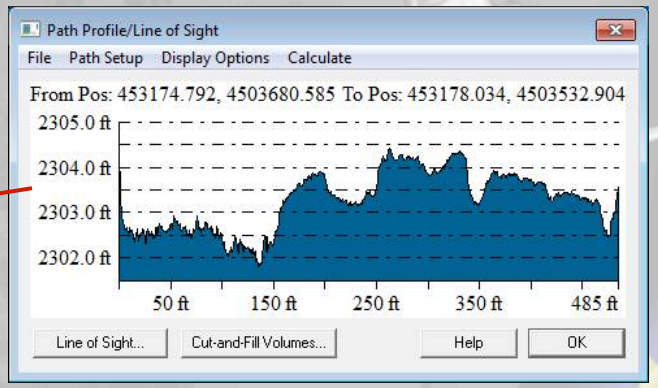


Emergent Sandbar Habitats

Platte River, Nebraska







Mapping the spatial extent and elevation of emergent sandbars along two reaches of the Platte River for endangered or threatened nesting birds (least terns and piping plovers)

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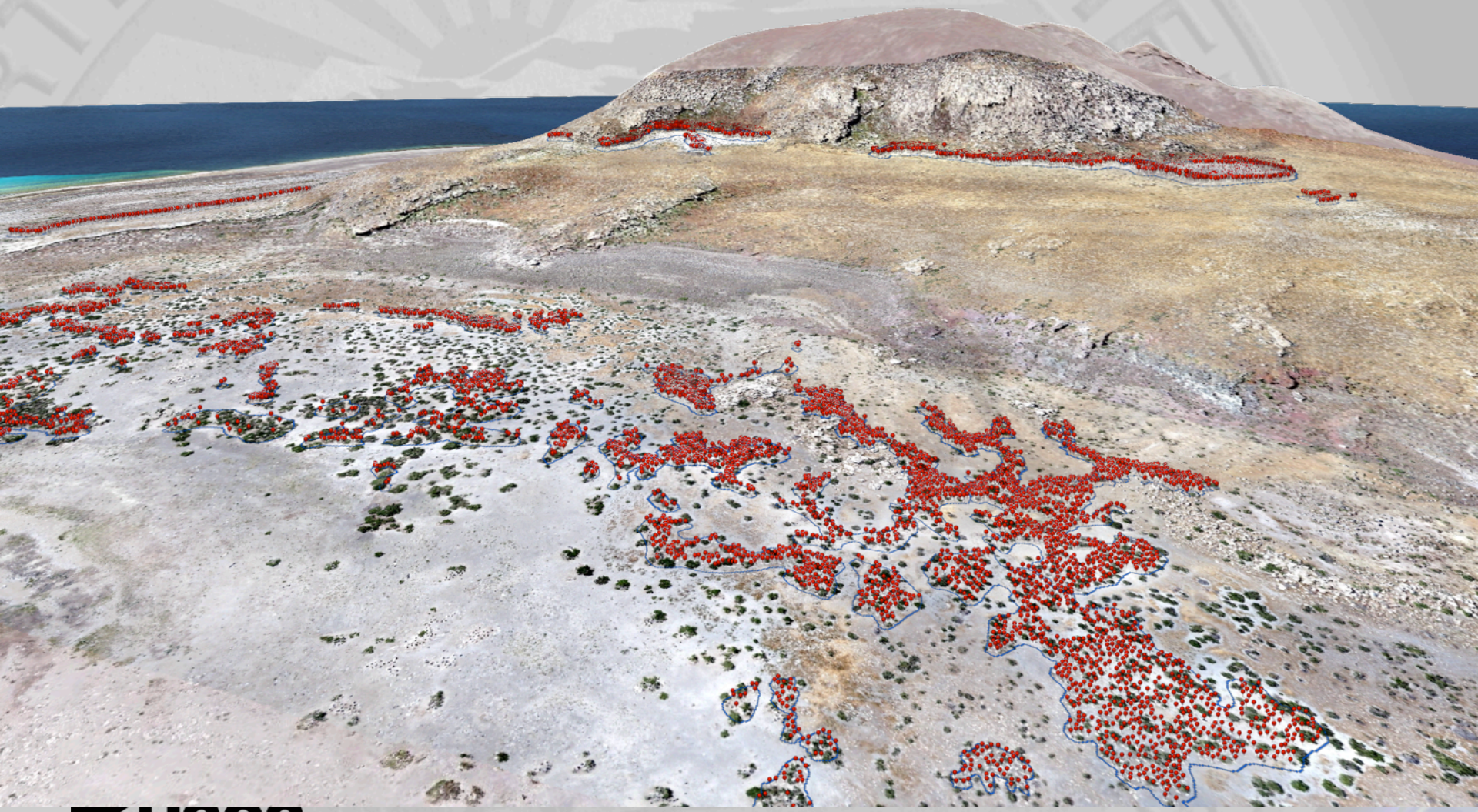
Pelican Nesting Habitats

Pryamid Lake, Reno, NV



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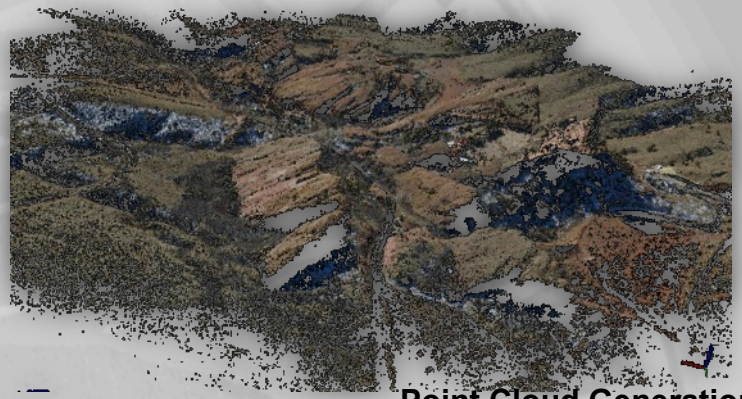
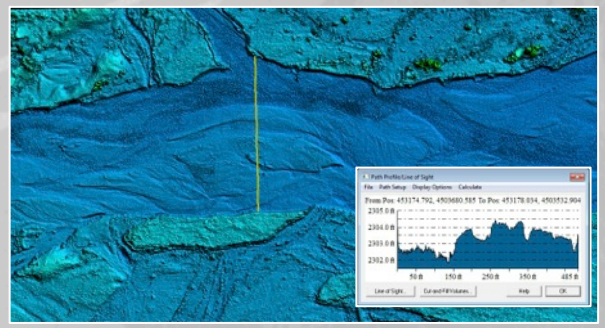
Geospatial Data Products

Color Infrared - NDVI

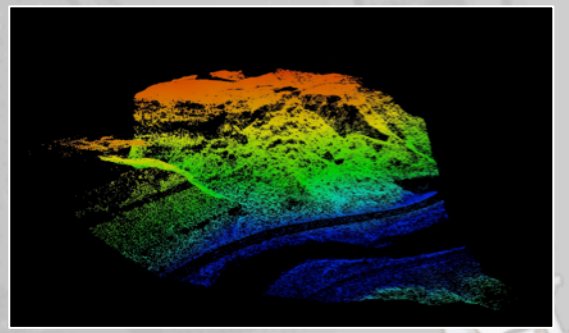


Point Cloud Generation



Elevation Models

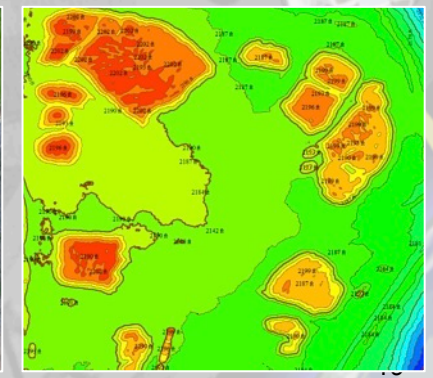
Feature Extraction



KML – 3D Modeling

Orthophotography

Volumetric Measurements



Contour Generation

UAS Data Processing

Color Infrared & Normalized Difference Vegetation Index (NDVI)

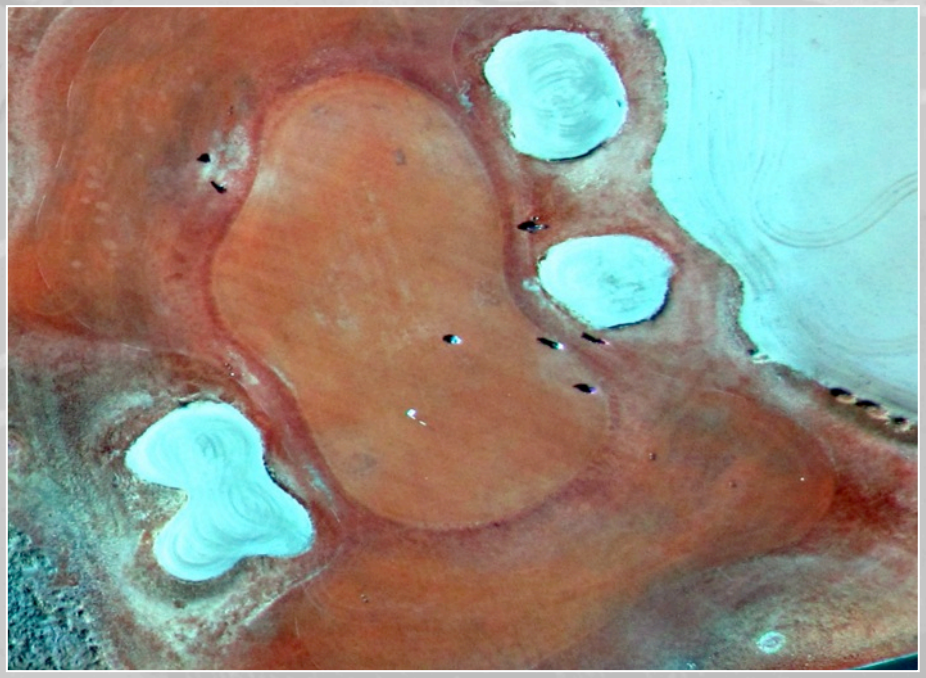
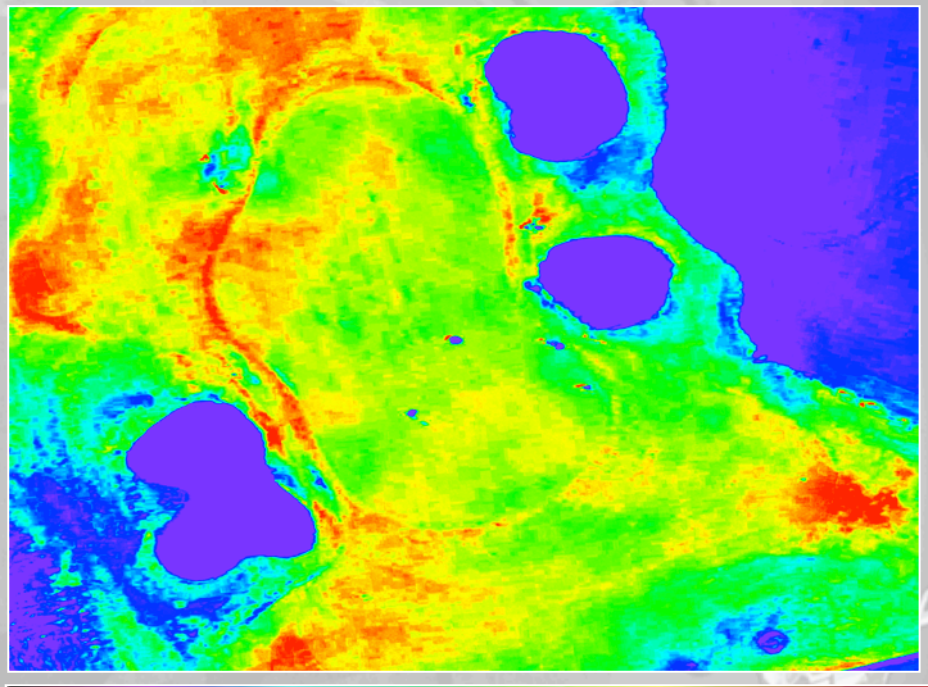


Image collected from UAS – Canon SX230 HS – 400’



NDVI Low NDVI High

$$\mathrm{NDVI} = \frac{(\mathrm{NIR} - \mathrm{VIS})}{(\mathrm{NIR} + \mathrm{VIS})}$$

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Lake Havasu, AZ

WorldView 2 – Multispectral (pan sharpened)

UAS – Canon s100 (modified blue filter)

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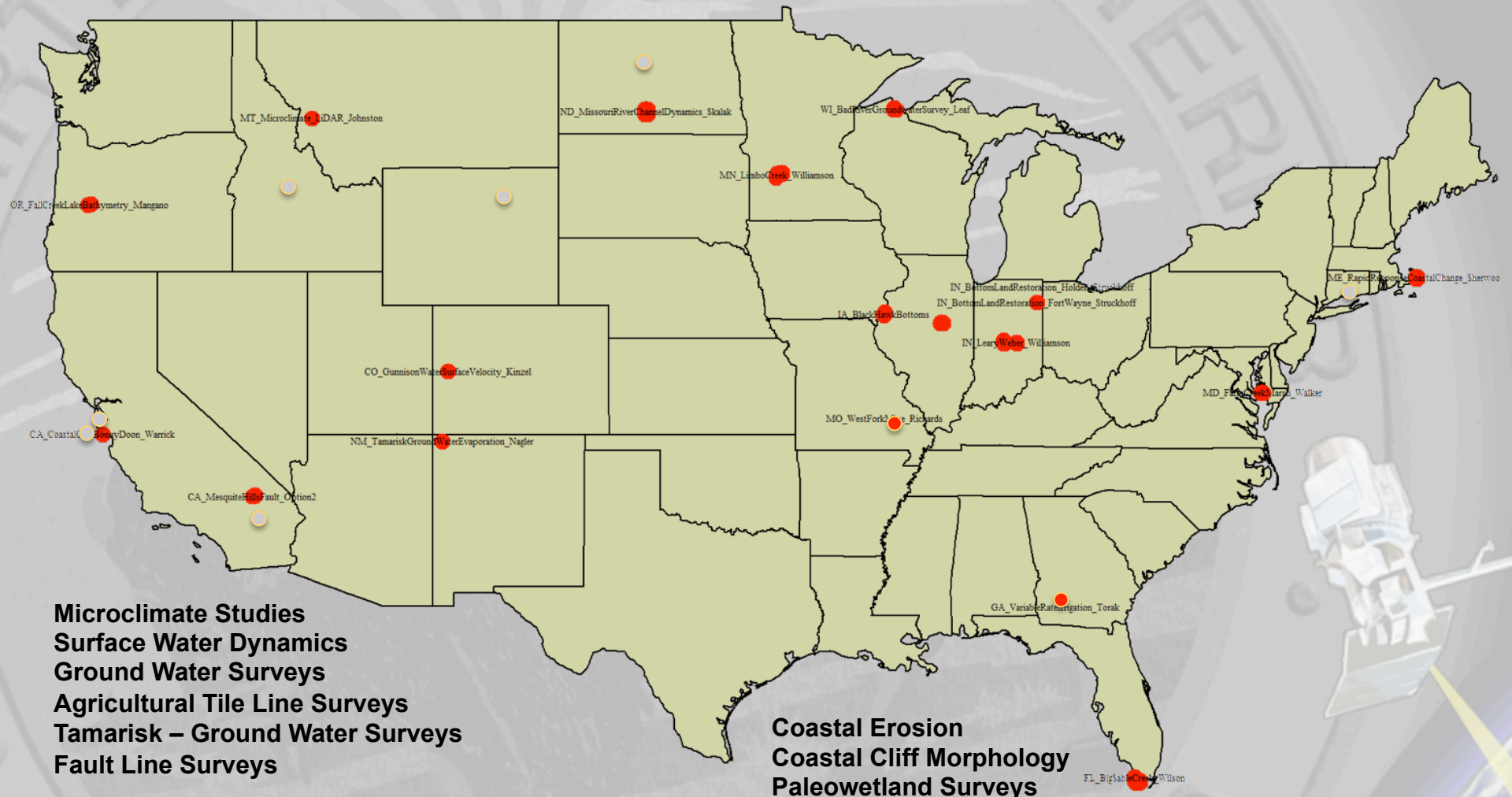
2016 USGS UAS Work



Microclimate Studies
Surface Water Dynamics
Ground Water Surveys
Agricultural Tile Line Surveys
Tamarisk – Ground Water Surveys
Fault Line Surveys

Coastal Erosion
Coastal Cliff Morphology
Paleowetland Surveys
Asian Carp, Waterfowl, Sea Turtle, Fur Seal Surveys
Mine Surveys

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Facts and Issues

How do I get started – contact Bill, Jeff or Bruce, attend monthly call

How can I get UAS data –

- **NUPO**
- **Collaboration with university or other agency**
- **Commercially (333 company or USGS Geospatial Product and Service Contract)**
- **Set up your own capability**

What are the costs –

- **UAS: micro ($1-3K?), Falcon ($25-$29K), Pulse ($143K)**
- **Sensors: cameras ($300-1,200), lidar ($8K), multi/hyperspectral ($2-50K)**
- **Data collection: $25-$75/hour**
- **Processing software: PhotoScan ($3K), Pix4D ($6K)**

Data Management – EROS draft UAS Data Management Plan

- **Presidential memo on collection, use, retention and dissemination of UAS data, February 2015**

Will spend more time pre-flight and post-flight than actually flying

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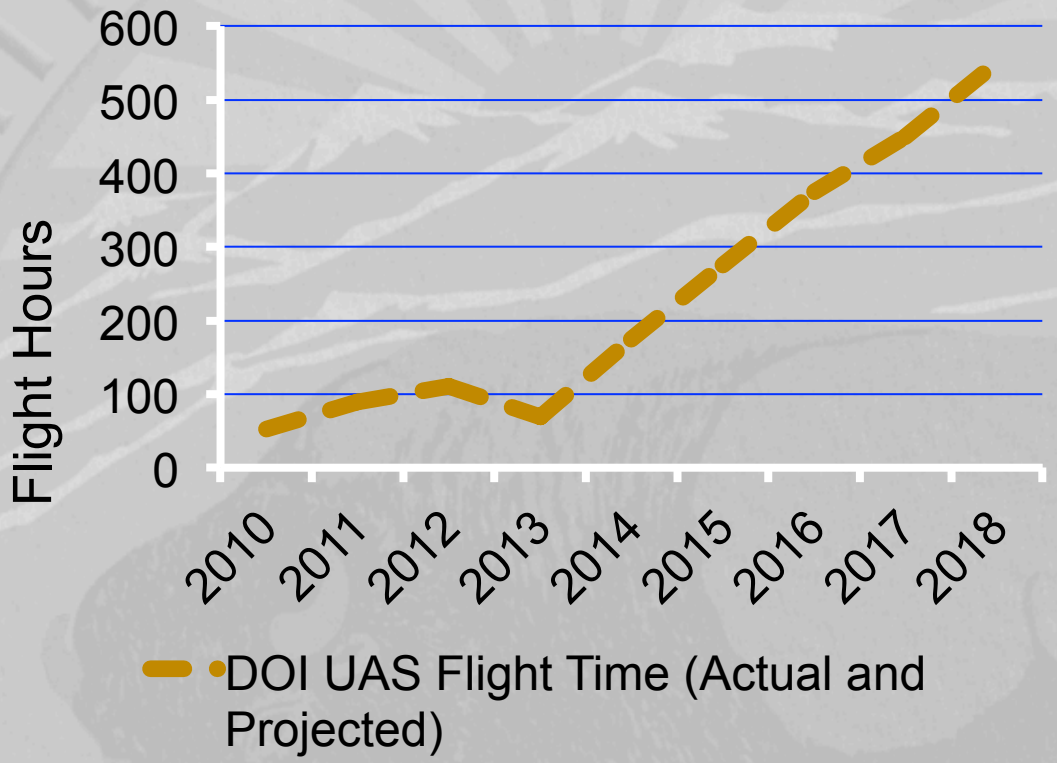
Questions?



Websites: http://uas.usgs.gov/

https://www.doi.gov/aviation/uas

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